WHAT IS CLAIMED IS:

1. An optical automatic control encoder, with a diffraction grating, which is immune from an unevenness of a grating surface interval, and has a high tolerance to a alignment error, at least comprising:

a light source, which generates a light beam having a sufficient coherence length;

an optical scale, having the diffraction grating, used to detect a displacement of an object that is under measured;

an optical head, which polarizes a single input signal light beam for providing outputs of two parallel light beams each having one linear polarizing state perpendicular to each other, and combines the two parallel light beams into a single output signal light beam, wherein since the a polarizing switch mechanism exists in a beam path, the single input signal light beam and the single output signal light beam can be shifted in position to apply both an input mechanism and an output mechanism simultaneously,

wherein the optical head splits the single input signal light beam into a first incident light and a second incident light, wherein both the first incident light and the second incident light are linearly polarized and perpendicular to each other,

wherein a polarizing direction of the first incident light is switched to be perpendicular to the original polarizing direction by passing through a first polarizing state switching mechanism, and a polarizing direction of the second incident light is also switched to be perpendicular to the original polarizing direction by passing through a second polarizing state switching mechanism, and the first incident light and the second incident light are transferred from the linear polarizing state to a circular polarizing state, and subsequently focus on the diffraction grating of the optical scale respectively;

wherein an angle between the direction of the first incident light and a normal direction of a plane of the diffraction grating must be sufficiently approximate to a first +1 order diffraction angle of the grating; a first +1 order diffraction light is generated after incidence, the first +1 order diffraction light is approximately perpendicular to the diffraction grating plane; an angle between the direction of the second incident light and the normal line direction of the diffraction grating plane must be approximately enough to the first -1 order diffraction angle of the grating;

wherein the first -1 order diffraction light is generated after being incident, the first -1 order diffraction light is approximately perpendicular to a diffraction grating plane; the first +1 order diffraction light is reversely incident onto the diffraction grating after reflection and a second +1 order diffraction light is generated; the second +1 order diffraction light coincides with the first incident light in space but a traveling direction is reverse; the first -1 order diffraction light is perpendicularly incident onto the linear diffraction grating and a second -1 order diffraction light is generated, the second -1 order diffraction light coincides with the second incident light in space but a traveling direction is reverse; after the polarizing state of the second +1 order diffraction light and the second -1 order diffraction light had been changed from the circular polarizing state back to the linear polarizing state again, the second +1 order diffraction light travels along the reverse direction of the first incident light, and a first output light beam is output by position shifting; the second -1 order diffraction light travels along a reverse direction of the second incident light and a second output light beam is output by position shifting; and the polarizing direction of the first output light beam is perpendicular to the polarizing direction of the second output light beam, these two output light beams can not be distinguished in space and form a signal light beam; and

a light signal analyzing system, which is used to split the signal light beam and detects a variation of light intensity; split the signal light beam equally into a first signal light beam and a second signal light beam; further split the first signal light beam into a first orthogonal light beam and a second orthogonal light beam, detect the first orthogonal light beam and the second orthogonal light beam and generate a first orthogonal signal and a second orthogonal signal with a phase difference between the first orthogonal signal and the second orthogonal signal, whereby a first orthogonal signal can be obtained by differentiating the first orthogonal signal and the second orthogonal signal; split the second signal light beam into a third orthogonal light beam and a fourth orthogonal light beam and detects the third orthogonal light beam and the fourth orthogonal light beam to generate a third orthogonal signal and a fourth orthogonal signal with a phase difference between the third orthogonal signal and the fourth orthogonal, whereby a second orthogonal signal can be obtained by differentiating the third orthogonal signal and the fourth orthogonal signal, wherein the first orthogonal signal and the second orthogonal signal have a phase difference of 90 degrees.

2. The optical automatic control encoder according to claim 1, wherein the diffraction grating in the optical scale is a linear diffraction grating.

3. The optical automatic control encoder according to claim 1, wherein the diffraction grating in the optical scale is a cylindrical diffraction grating.

4. The optical automatic control encoder according to claim 1, wherein the diffraction grating in the optical scale is a radiate diffraction grating.

5. The optical automatic control encoder according to claim 1, wherein the optical head comprises at least:

a polarizer, which provides the polarizing mechanism and a reflecting mechanism and a transmission mechanism due to the polarizing direction;

a right-angle reflector, which provides a reflecting mechanism and a position shifting mechanism;

a quarter-wave plate, which forms the first polarizing state switch mechanism by associating with the right-angle reflector;

a first planar reflector, which provides the reflecting mechanism;

a second quarter-wave plate, which forms the second polarizing state switch mechanism by associating with the first planar reflector;

a convex lens, which leads the two parallel lights that are output from the polarizer to the application system, and receives the diffraction light signal that is generated by the diffraction grating;

a third quarter-wave plate, which is located between the polarizer and the convex lens, to rotate the light polarizing state of the first incident light;

a fourth quarter-wave plate, which is located between the polarizer and the convex lens, to rotate the light polarizing state of the second incident light; and

a second planar reflector, which provides the reflecting mechanism for the first +1 order diffraction light and the first -1 order diffraction light, and associates with the third quarter-wave plate and the fourth quarter-wave plate to form a third polarizing state switch mechanism and a fourth polarizing state switch mechanism.

6. The optical automatic control encoder according to claim 1, wherein the light signal analyzing system comprises:

a quarter-wave plate, which transfers the single input signal light beam from a linear polarizing state to the circular polarizing state;

a first non-polarizer, which extracts a portion of the single input light beam to form a reference light beam;

a light detector, which receives the reference light beam and provides the signal that is needed for a source light power modulation;

a second non-polarizer, which evenly splits the residual signal light beam that passed through the light rotation-polarizing element, into a first signal light beam and a second signal light beam;

a first polarizer, which evenly splits the first signal light beam into a first orthogonal light beam and a second orthogonal light beam; and

a second polarizer, which evenly splits the second signal light beam into a third orthogonal light beam and a fourth orthogonal light beam.

7. The optical automatic control encoder according to claim 5, wherein the right-angle reflector includes a corner cube reflector having the silver coated film.

8. The optical automatic control encoder according to claim 5, wherein each of the first quarter-wave plate and the second quarter-wave plate includes a direct coating film on an exterior of the right-angle reflector.

9. The optical automatic control encoder according to claim 5, wherein the third quarter-wave plate and the fourth quarter-wave plate are a same quarter-wave plate, and the second planar reflector can be put on a center of the quarter-wave plate to simplify the configuration of those two quarter-wave plates and the planar reflector.